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(54) Title: PROCESS FOR RENDERING NUTRITIONAL AND INDUSTRIAL PROPERTIES IN SEEDS EASILY ASSIMILABLE

(57) Abstract: The invention provides a process for rendering various nutritional and industrial properties in certain seeds of the plant families amaranthaceae, leguminoceae, cruciferum, chenopodiaceae and brassica easily assimilable and/or suitable for industrial use, the process including the steps of continuously heating seeds to a predertermined temperature, stabilising seeds at the temperature and then allowing the seeds to cool to ambient conditions.

PROCESS FOR RENDERING NUTRITIONAL AND INDUSTRIAL PROPERTIES IN SEEDS EASILY ASSIMILABLE

INTRODUCTION TO THE INVENTION

This invention relates to the processing of food or industrial products and more particularly to the processing of food or industrial products out of certain of the seeds of the plant families amaranthaceae, leguminoceae, cruciferum, chenopodiaceae and brassica.

This invention also provides for the preparation of composite food or industrial products by combining, integrating or otherwise embodying the processed seeds together with other substances or products.

BACKGROUND OF THE INVENTION

The seeds of the members of the amaranthaceae, leguminoceae, cruciferum, chenopodiaceae and brassica families, and particularly soya beans of the plant genus glycine, are rich in nutrients and have properties which make them suitable for industrial use. Assimilable proteins and other macro and micro nutrients have been obtained by processing these seeds and certain of these

processing procedures are well known and have been used, particularly in Asia, for many years.

The processing of seeds of the types referred to is undertaken to render the food palatable, digestible and, as far as possible, to release their nutrient content in an easily assimilable form while maintaining anti-nutritive substances to as low a limit as possible. The nutritional content of the food obtained has been studied and is well known to those skilled in the art. Seeds of the types referred to rank high on listings of nutrient-rich foods or industrial raw materials, and processing in different ways look to different protein combinations, nutrients and potentials being available for nutritional and industrial use.

OBJECT OF THE INVENTION

It is the object of the present invention to provide a process for certain of the seeds of the plant families amaranthaceae, leguminoceae, cruciferum, chenopodiaceae and brassica which will render various properties in these seeds nutritionally assimilable and/or suitable for industrial use.

SUMMARY OF THE INVENTION

In accordance with this invention there is provided a process for rendering various nutritional and industrial properties in certain seeds of the plant families amaranthaceae, leguminoceae, cruciferum, chenopodiaceae and brassica easily assimilable and/or suitable for industrial use comprising continuously heating seeds to a predetermined temperature, stabilising seeds at the temperature and then allowing the seeds to cool to ambient conditions.

Further features of the invention provide for the seeds to be whole or fragmented; and for cooling to be by complete or partial removal of heat from the seeds or by induction with cooling apparatus.

Still further features of the invention provide for the seeds of the plant family leguminoceae to be heated to a temperature of up to 210°C within 12 minutes and to be stabilised at the temperature for a period of up to 20 minutes prior to cooling.

Yet further features of the invention provide for the seeds of the plant families amaranthaceae, cruciferum, chenopodiaceae and brassica to be heated to a temperature of up to 120°C within a period of 10 minutes and to be stabilised at the temperature for a period of up to 15 minutes prior to cooling.

Further features of the invention provide for light, or light filtered to control the emission of radiation or irradiation, to be applied to the seeds during the process.

Still further features of the invention provide for the seeds to be heated in apparatus at least partially filled with nitrogen; and for the apparatus to be operated at any pressure relative to atmospheric pressure.

Yet further features of the invention provide for the seeds to be reduced in size if required by a market or on-process at any stage during or subsequent to processing by splitting, milling or in any other way to any required size for consumption either immediately or following intermediate storage or holding.

The invention also provides for the use of processed seeds as defined above in the preparation of a food or industrial product.

Further features of the invention provide for use of the processed seeds in the preparation of the food or industrial product to be by way of baking, blending,

supplementing, beneficiation or integration; and for such use to occur immediately after processing or after a period of storage.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Two examples of a process according to the invention are described below by way of example only.

Example 1

According to this example, whole dried seeds of the plant family leguminoceae are introduced into a vessel which is pre-heated to a temperature of 160°C. The seeds are allowed to to stabilise at this temperature for a period of 12 minutes whereafter they are allowed to cool to ambient temperature.

Hereafter, the processed seeds are available for use.

Example 2

According to this example, whole seeds of the plant family amaranthaceae, cruciferum, chenopodiaceae or brassica are introduced into a vessel which is partially filled with nitrogen gas. The seeds are then heated to a maximum temperature of 120°C within a period of 10 minutes and allowed to stabilise at the temperature for up to 15 minutes. Hereafter the seeds are allowed to cool to ambient temperature.

In respect of both Examples 1 and 2 it has also been found that light can be applied to the seeds at any stage during the process. The light is preferably

filtered to control the emission of radiation or irradiation, including infrared radiation and ultraviolet irradiation. Light has been found to reduce the original presence of phenols and to prevent the formation of new phenols during the process as phenols are light sensitive. The action of light also prevents certain molecular structures from going into a reverse action due to the light-sesitivity of suchmolecules during certain stages of the process. The action of light also influences the activity of various vitamins in relation to the formation of bacterias during the process. The light can be applied intermittently or continuously for any suitable period of time.

Furthermore, processing can take place at any pressure relative to atmospheric pressure and the seeds could be processed in a fragmented condition

Cooling of the seeds can be achieved by either the complete or partial removal of heat or by induction using cooling apparatus. Also, the seeds could be whole or fragmented during processing.

With seeds of the plant family leguminoceae it has been found that a maximum temperature of 210°C can be used in the process, that heating to the selected temperature should occur within a maximum of 12 minutes and that stabilisation at the temperature should not be longer than 20 minutes.

The temperature and times of heating may vary widely dependent upon raw material and environmental conditions and/or the seed genus or genera under process. It is envisaged that conditions will have to be closely monitored to ensure that the required results are being achieved and that such conditions may vary from batch to batch. Heating may be affected by micro or other high or low-frequency waves, radiation, induction or by the application of dry steam, or any combination of these, provided the heating is dry heating. In the context of this invention, the tem "dry heating" is to be construed to mean at any moisture load as results from the interaction of prevailing atmospheric conditions and/or

process and/or product characteristics, but excluding any deliberate artificial input of moisture.

The above examples are thus not be considered as limiting the invention and could include a combination of the above processes provided that the seeds are heated to a predetermined temperature, stabilised at the temperature and thereafter cooled to ambient temperature.

The process utilises the seed's own inherent characteristics to effect changes in structure under heating and uses the application of light and/or an artificially induced presence of nitrogen as the only supplementary mediums. No substances otherwise are added to, applied or detracted from the seeds.

Processing of the seeds as described denatures certain molecular structures from their original state, resulting in, but not limited to, the rearranging, modifying, combining, reducing, and/or formation of structures which, *inter alia*, include structures described as amino acids, proteins, vitamins, enzymes, bacteria, viruses, minerals and/or fatty constituents.

The process results in, but is not limited to, the modification of certain amino acids and/or amino acid chains by the activation, control and/or modification of certain enzymes, bacteria and/or viruses naturally present, by, but not limited to, esterification, fermentation and/or monomer/dimer reaction.

The denaturing of hydrocarbon bondings results in certain conversions to peptide bondings by, *inter alia,* monomer/dimer actions and/or chain reactions and the re-arranging of certain bonded structures and/or the transfer of certain chemical structures and/or the modification of certain atomic structures, in part or whole. The number of reactions and potential reactions which occur are in fact too numerous to enumerate and some are not fully understood.

The formation of trivalent bondings of peptides will set complete protein molecules free (that is, produce unbonded forms). Certain amino acid structures will also be modified to set-free complete protein molecules and/or molecular structures of "essential" and "non-essential" amino acid bases and other potentials, thereby increasing nutritional values and/or enhancing the suitability for nutritional or industrial applications.

Trypsin inhibitors are controlled by, but not limited to specific time, temperature and/or environmental conditions, and certain light-sensitive constituents, which include certain anti-nutritive factors, are reduced and/or modified by the strategic application of light, heat and/or environmental conditions prior, during or subsequent to the process. As indicated above, the process conditions used will depend on the characteristics of the seeds used and the prevailing environmental conditions.

Certain undesirable bacteria, moulds and yeasts are controlled and certain viruses, enzymes and bacteria naturally present are controlled and/or modified to provide certain anti-bacterial and/or antibiotic characteristics. It is difficult to specifically quantify such actions due to the enormous number of potential reactions and because some of the actions are not fully understood.

The products derived from the above process whether whole or in fractions may be composite food and industrial substances obtained at economical cost, to be used either without further beneficiation, or in combination with any other product, manufacture, substance or raw material.

Additionally, certain constituents may be isolated from the product to be used either without further beneficiation, or in combination with any other product, manufacture, substance or raw material.

The process will however preferably be controlled to yield a product having a percentage protein yield in the range of up to 45 per cent, dependent upon the seed genus or genera under process.

The process is monitored to ensure that micro-organism growth after primary processing falls within the following average specifications:

Getrimide Agar	-	after 72 hours	:	no growth
Baird-Parker Agar	-	after 72 hours	:	no growth
Vogel & Johnsons Agar	-	after 72 hours	:	no growth

Also, the process is monitored to ensure that colony formation will be controlled to a total number of:

Aerobes	:	Max. 1 x 10 to the power of 3 Casoy Agar – 300/g after 5 – 7 days
Moulds	:	Max. 1 x 10 to the power of 2 SABS Agar – 45/g after 5 – 7 days
Yeasts	:	Max. 1 x 10 to the power of 2 SABS Agar – 25/g after 5 – 7 days

The process conditions may thus be adjusted from time to time to ensure that the above requirements are met.

It is further envisaged that only raw seeds will be treated and that such seeds will be treated in an unprocessed state. "Unprocessed" in this sense means that the seeds will not have had their physical structure altered.

According to the invention the processed seed can be used in the preparation of a food or industrial product, whether in itself or in combination with any other raw material, manufacture or product. Such products may include other substances or raw materials and use could be by way of any one or more of the following methods either immediately after processing or after a period of storage:

Baking;	which term shall include toasting, roasting and grilling;
Blending;	which term shall include combining, infusion, suffusion, transfusion, inclusion, coalescence, mixture, admixture and amalgamation;
Supplementing;	which term shall include fortifying, complement, addition and substitution;
Beneficiation;	which term shall include sacrificial; and
Integration;	which term shall include embodiment.

The seeds processes according to the invention can be used for purposes of nutrition or to combat malnutritional conditions brought about by nutritional deficiencies irrespective of causation, as well as in industrial processes.

CLAIMS

1. A process for rendering various nutritional and industrial properties in seeds of the plant families amaranthaceae, leguminoceae, cruciferum, chenopodiaceae and brassica easily assimilable and/or suitable for industrial use, comprising continuously heating seeds to a predetermined temperature, stabilising seeds at the temperature and then allowing the seeds to cool to ambient conditions.

2. A process as claimed in claim 1 wherein the seeds are whole or fragmented.

3. A process as claimed in claim 1 or claim 2 wherein the seeds are cooled by way of complete or partial removal of heat from the seeds.

4. A process as claimed in claim 1 or claim 2 wherein the seeds are cooled by induction with cooling apparatus.

5. A process as claimed in any one of the preceding claims wherein seeds of the plant family leguminoceae are heated to a predetermined temperature of up to 210°C.

6. A process as claimed in claim 5 wherein the seeds are heated to the predetermined temperature within 12 minutes.

7. A process as claimed in claim 5 or claim 6 wherein the seeds are stabilised at the predetermined temperature for a period of up to 20 minutes prior to cooling.

8. A process as claimed in any one of claims 1 to 4 wherein seeds of the plant families amaranthaceae, cruciferum, chenopodiaceae and brassica are heated to a predetermined temperature of up to 120°C.

9. A process as claimed in claim 8 wherein the seeds are heated to the predetermined temperature within 10 minutes.

10. A process as claimed in claim 8 or claim 9 wherein the seeds are stabilised at the predetermined temperature for a period of up to 15 minutes prior to cooling.

11. A process as claimed in any one of the preceding claims wherein light is applied to the seeds during the process.

12. A process as claimed in claim 11 wherein the light is filtered to control emission of either or both of radiation or irradiation.

13. A process as claimed in any one of the preceding claims wherein the seeds are heated in an apparatus at least partially filled with nitrogen.

14. A process as claimed in any one of the preceding claims wherein the seeds are heated in an apparatus operated at a pressure above or below atmospheric pressure.

15. A process as claimed in any one of the preceding claims wherein the seeds are reduced in size during or subsequent to heating.

16. A process as claimed in any one of the preceding claims wherein the seeds are raw.

17. A process as claimed in any one of the preceding claims wherein the seeds are unprocessed.

18. Use of seeds processed in accordance with any one of the preceding claims in the preparation of a food or industrial product.

19. Use of the seeds as claimed in claim 18 wherein the food or industrial product is prepared by any one or more of baking, blending, supplementing, beneficiation and integration.

20. A process for rendering various nutritional and industrial properties in seeds of the plant families amaranthaceae, leguminoceae, cruciferum, chenopodiaceae and brassica easily assimilable and/or suitable for industrial use substantially as herein described and as exemplified with reference to Example 1 or Example 2.

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A23L1/36 A23L1/20 A23L1/201 A23L1/01 A23L1/211
A23L1/10 A23L1/182 A23B9/02 A23B9/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A23L A23B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, FSTA, BIOSIS, MEDLINE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 662 958 A (KENNELLY JOHN JOSEPH ET AL) 2 September 1997 (1997-09-02) column 2, line 65 - line 12 column 3, line 59 -column 4, line 2 column 4, line 66 -column 5, line 6; claims 1,3-5; example 1	1-4, 8-11, 16-20
X	US 5 296 253 A (LUSAS EDMUND W ET AL) 22 March 1994 (1994-03-22) column 2, line 18 - line 38; claims 1-5,7-11; example 1	1-7,11, 14-20
X	US 6 221 380 B1 (COCKBILL ALAN WILLIAM ET AL) 24 April 2001 (2001-04-24) column 3, line 63 -column 4, line 12 column 5, line 9 - line 22; claims 1-3	1-11,14, 16-20

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 540 793 A (CESKE VYSOKE UCENI TECH V PRAZ) 14 February 1979 (1979-02-14) page 1, line 11 - line 22 page 2, line 47 - line 59; claims 1,2	1-7,11, 12,15-20
X	US 5 264 231 A (THOMAS REMI) 23 November 1993 (1993-11-23) column 1, line 28 - line 40; claims 1-5; example	1-4, 8-11,14, 16-20
X	US 3 457 087 A (RENNER HERBERT O) 22 July 1969 (1969-07-22) claims 1,2; examples VII,,VIII	1-7,11, 16-20
X	US 5 151 285 A (WILLIAMS RICK L ET AL) 29 September 1992 (1992-09-29) claims 19-23; figure 1	1-7,11, 12,15-20
X	US 4 252 833 A (ZVONICEK JAN ET AL) 24 February 1981 (1981-02-24) column 1, line 18 - line 23; claim; table II	1-7,11, 12,16-20
X	US 5 069 923 A (HUBBARD EDWARD S ET AL) 3 December 1991 (1991-12-03) column 7, line 45 - line 51; claims 10,15,16,19	1-4, 16-20
X	US 3 876 807 A (BECKER ROBERT ET AL) 8 April 1975 (1975-04-08) column 1, line 19 -column 2, line 3; claims 1,2,5-7; example 5	1-7,11, 16-20
X	EP 0 388 261 A (R C L) 19 September 1990 (1990-09-19) claims 5-7; examples 1-3,COMPARATIVE,1-3	1-7,11, 14,16-20
X	EP 0 811 325 A (NESTLE SA) 10 December 1997 (1997-12-10) column 2, line 4,5; claims 1,3,6,8,9	1-7,11, 14,16-20
X	CH 679 104 A (BUEHLER AG) 31 December 1991 (1991-12-31) column 1, line 9 - line 17; claims 2,3,5; examples 1-10 column 2, line 8 - line 11 column 2, line 45 - line 53	1-7,11, 13,16-20

INT NATIONAL SEARCH REPORT

Inf on on patent family members

Inf tl lication No
PCT/IB 02/04709

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5662958 A	02-09-1997	CA 2121378 A1	17-10-1994
US 5296253 A	22-03-1994	NONE	
US 6221380 B1	24-04-2001	AU 3106495 A	07-03-1996
		WO 9604803 A1	22-02-1996
		JP 10506781 T	07-07-1998
		NZ 506199 A	31-05-2002
GB 1540793 A	14-02-1979	NONE	
US 5264231 A	23-11-1993	EP 0515706 A1	02-12-1992
		AT 128820 T	15-10-1995
		CA 2067516 A1	17-11-1992
		DE 69113786 D1	16-11-1995
		DE 69113786 T2	14-03-1996
		DK 515706 T3	29-01-1996
		ES 2078991 T3	01-01-1996
		GR 3018457 T3	31-03-1996
		JP 5252913 A	05-10-1993
		MX 9202231 A1	01-09-1992
US 3457087 A	22-07-1969	NONE	
US 5151285 A	29-09-1992	US 5213831 A	25-05-1993
US 4252833 A	24-02-1981	NONE	
US 5069923 A	03-12-1991	NONE	
US 3876807 A	08-04-1975	NONE	
EP 0388261 A	19-09-1990	FR 2644325 A1	21-09-1990
		AT 89131 T	15-05-1993
		DE 69001574 D1	17-06-1993
		DE 69001574 T2	18-11-1993
		DK 388261 T3	07-06-1993
		EP 0388261 A1	19-09-1990
		ES 2055355 T3	16-08-1994
EP 0811325 A	10-12-1997	EP 0811325 A1	10-12-1997
		AT 214552 T	15-04-2002
		DE 69619969 D1	25-04-2002
		DE 69619969 T2	29-08-2002
		ES 2172628 T3	01-10-2002
		PT 811325 T	31-07-2002
CH 679104 A	31-12-1991	CH 679104 A5	31-12-1991
		CN 1050125 A ,B	27-03-1991
		JP 3098249 B2	16-10-2000
		JP 3112458 A	14-05-1991